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APPLICATION OF DE VRIES'S MUTATION THEORY TO THE MOLLUSCA

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PROBABLY no work since the publication of Darwin's *Origin of Species* has produced such a profound sensation in the biological world as the work entitled *Die Mutationstheorie*, by Hugo de Vries. A perusal of that work (or, perhaps better for those not having the time, the shorter work *Species and Varieties; their Origin by Mutation*) leads the zoölogist to ponder upon the question as to how far these theories may be used in connection with animal forms, especially with the invertebrates. Much experimentation, covering a long period of time, must be done, however, before anything definite can be accomplished. De Vries spent twenty years raising and studying primroses. The zoölogist must do likewise and study some common forms for a long period, breeding them under conditions conforming as closely as possible to the natural environments of the organisms. The question of elementary species and varieties is one which would seem to have a meaning in botany somewhat different from the use of the same terms in zoölogy, in fact, in some of the Invertebrata (the Mollusca, for example) there would seem to be no distinction between an elementary species and a variety, the terms being synonymous. However this may be, it would seem that to the Mollusca the de Vries theory might be applied with some interesting results. The writer would ask the question: Are not many of the variations of the Mollusca produced in the manner outlined by this new aspect of evolution? The writer does not feel warranted

in answering this question in the affirmative, but he does believe that the illustrations which follow are suggestive and certainly point to some such derivation. It is not held, even by de Vries, I take it, that the mutation theory is to supplant or take the place of the older evolution by whose slow and gradual processes (natural selection, survival, environment, distribution, etc.) the present state of animal and vegetal matter has been reached, but as an additional process in that great scheme of life.

In certain mollusks the species seem to be unstable, that is, they have a tendency to vary, not in a given direction but in many

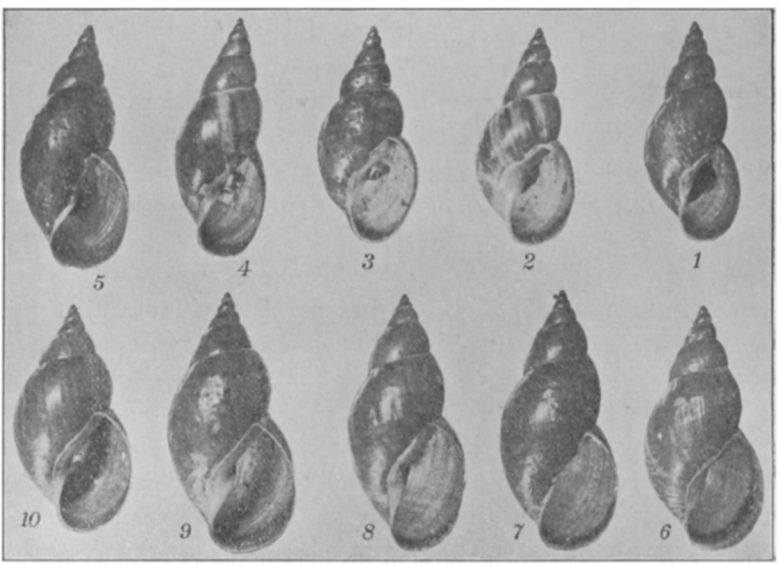

FIG. 1.— *Lymnæa palustris* Müller, from Halma, Minnesota. Note the wide range of variation in the form of the shell. Enlarged.

directions at the same time. These seem to come under the head of mutants, or sports. The fresh-water pulmonates belonging to the genus Lymnæa are examples of this class and every species which has been studied in any quantity has been found to vary in this manner. *Lymnæa palustris* Müller (= *elodes* Say) is one of the most notably variable, and its mutations are many and marked. Fig. 1 represents a set of ten shells of this species collected by Mr. L. E. Daniels in Muskag swamps, Halma, Minnesota. They vary from a long, narrow shell, with elevated spire

(1) to a fat, robust shell, with a comparatively short spire (10). In some specimens the whorls are flat-sided (4), while in others they are convex, especially the last, which is very convex (3, 10). The columella plait also varies in size and elevation and the sutures vary in the degree of impression (compare 3, 4). Several of these mutations, if we can so designate these variations, have

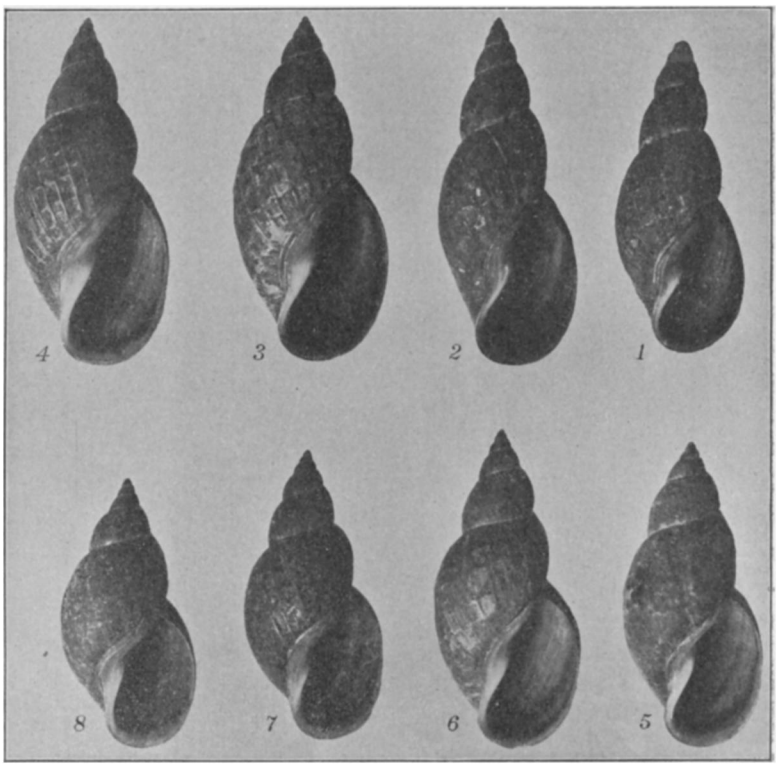

FIG. 2.— *Lymnæa palustris* Müller, from Sugar Island, Alpena, Michigan. Enlarged.

been described as species or varieties; thus 10 is Lea's *nuttalliana* and 1 is Say's *elodes*. It will be seen that no line can be drawn between 1 and 10 in the presence of the intervening figures. Take away these connecting links and a very distinct variety remains.

In the Mollusca the factor of geographic variation plays a very important part. The shells from the locality illustrated in Fig. 1 are rather small, measuring 23 mm. in length. Fig. 2 illustrates the same species from Sugar Island, near Alpena, Michigan (col-

lected by Dr. W. A. Nason); the shells are much larger than those of Fig. 1, and measure 30 mm. in length. It will also be noted that the variation in this lot of shells is not so marked as in those illustrated in Fig. 1. There is considerable difference between the extremes but the majority of specimens conform more or less to a single type, the large, corpulent form. A study of several hundred specimens from each locality shows that each lot varies a certain percentage toward a given form. In lot 1, (Fig. 1), the variation is 75 percent toward no. 1, while in lot 2 (Fig. 2) the variation is about 60 percent toward no. 8. Without more data to disprove it, this would seem to point to the fact that the species of each locality varies toward a definite form. In lot no. 1 the dominant form is *palustris*, while in lot no. 2 the dominant form is *nuttalliana*.

The interesting fact in connection with all this is (and this is where de Vries's mutation theory seems applicable) that all the forms illustrated will develop from the same egg capsule. The eggs laid by *nuttalliana* will produce narrow *palustris* as well as the fat parent form, while the narrowest *palustris* will likewise produce the fattest *nuttalliana*. May this not be an illustration, also, of two types (although this subject is treated under eversporting varieties by de Vries) which he calls poor races and rich races. In Fig. 1, 75 percent of the progeny are *palustris* (assuming that the parent was a *palustris* form) and are of the rich race, while in Fig. 2 (assuming the parent to be *palustris*) the progeny are of the poor form, only 40 percent being the *palustris* form. This, however, is only hypothetical in this case. Nothing but actual experimentation can give accuracy to this phase of the subject.

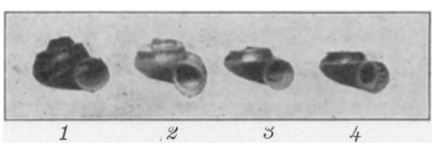

FIG. 3.— Variation in Valvata. 1. *V. tricarinata* Say. 2. *V. tricarinata confusa* Walker. 3. *V. bicarinata* Lea. 4. *V. bicarinata normalis* Walker. All enlarged.

In some other groups of shells the variation is along certain definite lines and the species seem to be more stable. For example, among the land shells *Polygyra profunda* and *Polygyra multilineata* vary in lacking or having bands, the uniform varieties being light (albino) or dark. *Polygyra tridentata* varies in its aperture

from no teeth through one, two, to three teeth. Some of the forms of Polygyra may be perforate or imperforate (*Polygyra monodon*, for example). In Valvata (Fig. 3) the variation seems to be still more marked, the variant being in the number and position of the carinæ; for example, *Valvata tricarinata* has three carinæ (1); var. *confusa* has two carinæ (2) and another variety has one carina. So also with *Valvata bicarinata*, which has two carinæ (3) while the variety *normalis* has three carinæ (4). *Vivipara contectoides* is another example in point, the typical form being banded, while a variety is without bands. These variations would seem to conform to de Vries's retrograde varieties, differing from the parent species in the absence of one or two characters. The majority of the latter examples are true varieties, lacking some characteristics of the type form, while the variations of Lymnæa are mutations combining most of the characteristics of the parent form. It is to be noted, however, that these two conditions overlap each other, so that no sharp and fast line can be drawn between them.

Some of the paleontologists have hailed de Vries's theory with delight, for they say that it is only in the light of such a theory that the sudden appearance of marked types in certain ancient faunas becomes intelligible. May it not also account for the finding of certain new species in regions supposed to have been thoroughly explored? May it not also account for the sudden disappearance of certain species, the mutations dying out but the parent form still continuing? A case in point is *Lymnæa shurtleffi* described from an artificial pond at Weatogue, Hartford Co., Connecticut. This species was found in large numbers, together with a new variety of Planorbis (*P. circumstriatus* Tryon). The finding of this Lymnæa is thus described by Mr. Tryon:[1] —

"The circumstances under which this and the following species were found are so peculiar that it is with great hesitation that I have ventured on a description of either of them. That new species of these shells should exist undetected in sections of the United States which have been so well explored by assiduous naturalists would be surprising; but in the present instance the almost irresistible supposition is, *that these species are of very*

[1] *Amer. Journ. Conch.*, vol. 2, p. 112, 1866.

recent origin [italics mine] in fact, *contemporaneous with that of the body of water which they inhabit.* I have looked in vain for some evidence upon the specimens themselves of the effect of some strong local influence. The species are so distinct that they afford no clew to a possible derivation from others.

"In conclusion, I present the following interesting particulars:

"Extract from a letter from the late Dr. S. Shurtleff to Isaac Lea, Esq., Weatogue, Hartford Co., Connecticut, November 22, 1865.

"In the summer of 1860 I made an excavation some two rods below a spring that flows about eight months in the year. The spring comes from a neighboring hill. The overlying rock is New Red Sandstone. From the time of the excavation till the summer of 1864 there was water in the artificial pond. It was dry in 1864, but I did not examine for shells, as before the excavation I had repeatedly examined the spring, but never found shells of any description.

"After my return from Pennsylvania, in September, 1865, accidentally crossing the pond, which was dry, I noticed quantities of shells clustered in the hollows. I gathered a few and laid them by for leisure examination; when I came to look at them again I found *L. umbrosa,* as I supposed, as well as a non descript species. I immediately went to the pond and secured all the Lymnæans I could find— some alive and many dead; and, fearing the dry season would destroy them all, I put many of the living shells into a pond that I have since made, that will never dry up. I may have collected 50 specimens of *L. umbrosa* (?) and of other specimens a half-pint.

"How these shells came into the pond is as much a matter of surprise to me as it is to you. I have no knowledge that there was ever a shell put into the pond.

"One fact more. The spring and pond are perfectly isolated, as the overflow disappears at the edge of a sandy plain in less than ten rods from its fountain head, and there is no stream of perpetual running water within one mile of it. The Farmington River is about a mile distant in the valley below, and here the only species yet found are *Lymnæa columella* Say, *Physa heterostropha* Say, *Planorbis bicarinatus* Say, *Vivipara decisa* Say, *Unio complanatus* Solander, and *Unio radiatus* Lamarck.

"The pond is two hundred feet above the bed of Farmington River."

Tryon says: "Besides the above two species I found a single specimen of *Lymnæa umbrosa* Say, and several of *L. desidiosa* Say."

From the foregoing account it would appear that *shurtleffi* (Fig. 4) was an offshoot (or mutant, if we apply the de Vries theory) of *umbrosa*[1] (= *elodes* = *palustris*), that being the only other species present (save *desidiosa*, which belongs to quite another group of Lymnæas). It may be thought by some that *shurtleffi* might have been produced by unfavorable conditions, but as the shells, one of the original lot of which was recently examined by the writer, are perfect and not distorted, this could hardly have been the case. All the evidence points to the conclusion that *shurtleffi* is a new species evolved or given off from *palustris*. The short, acute spire, subcylindrical, compressed body whorl, the partly open umbilicus, and the long and narrow aperture are the principal characteristics of the new species.

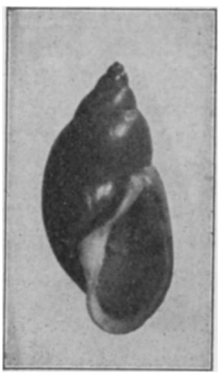

FIG. 4.— *Lymnæa shurtleffi* Tryon. Cotype. From Weatogue, Connecticut. Enlarged.

The foregoing remarks are not made with the idea of fastening the mutation theory upon the Mollusca, but only to call attention to these apparently analogous cases of mutation and variation to the end that other zoölogists may take up the matter and by experimentation and by the study of abundant material from various localities gather a large amount of data bearing upon this theory as applied to the Mollusca.

While the mutation theory seems to fit in very nicely in explaining the very large amount of variation in the fresh-water pulmonates, we must not be too hasty in applying this new theory, founded as it is upon plant variation, to animal life. Dr. J. A. Allen, in a

[1] *Umbrosa* is placed by some conchologists in the synonymy of *reflexa*. I have examined the type specimens in the Philadelphia Academy and they are good examples of *elodes*.

recent number of *Science*[1] calls attention to the danger of accepting this hypothesis without more conclusive proof, and I cannot do better than to close this communication with his remarks. He says: "While the mutation theory may be a good hypothesis to consider in respect to these peculiarly unstable groups of birds, it must be noted that the method of their origin and the results, as now known, are very unlike the methods and results of mutation in plants, as made known by de Vries. The facts and conditions are not to any great extent parallel. Instead of the resultant 'mutants' remaining constant and breeding true, as in the case of primroses, they are in this case unstable and are believed to interbreed freely with each other and the parent stock."

I am indebted to the following gentlemen for assistance in the preparation of this paper: Dr. Henry A. Pilsbry, Academy of Natural Sciences, Philadelphia, Pa., for the loan of a type specimen of *Lymnæa shurtleffi*; Mr. L. E. Daniels, La Porte, Indiana, for specimens of *L. palustris* from Minnesota; Dr. W. A. Nason, Algonquin, Illinois, for specimens of *L. palustris* from Michigan; and Mr. Frank M. Woodruff, Chicago Academy of Sciences, for making the excellent photographs which illustrate this paper.

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[1] "The Probable Origin of Certain Birds." *Science*, n. s., vol. 22, p. 431, 1905.